

WHEN AND WHY WE (SOMETIMES) FORGET REALLY IMPORTANT THINGS

Alan D. Castel and Matthew G. Rhodes

Introduction

Both authors have frequently had the following experience. We are on a flight and start talking to the person sitting next to us. Inevitably, the question is posed: “What do you do for a living?” Experience suggests that answering “I’m a psychologist” leads to assumptions about therapeutic expertise or a comment like, “so you must be reading my mind right now,” insight and skills that neither of us possess. Instead, a more precise answer that eliminates those assumptions is to respond “I study memory.” When comparing our experiences, we realized that the response to this description of our occupation seems to elicit a common reply. Often our seatmate will lean in and state “Oh, I’m just terrible at names and am always forgetting them.” While other information is forgotten (state capitals, plots to movies, parking spaces, keys, phones), these memory missteps are rarely recalled with the same level of frustration that accompanies people’s observations about forgetting names.

Fortunately (or unfortunately), the experience of forgetting names is a collective challenge that appears to plague most of us. This challenge may be one of the most frustrating quirks of memory and our awareness of the struggle illustrates how we attend to our memory failures. Indeed, we think about memory most when it fails us. These failures can range from the mundane (forgetting a name), to the embarrassing (forgetting an anniversary), to the horribly devastating (forgetting an infant in a hot car for hours). In this chapter, we review why people’s awareness of memory (metamemory) is critical and how it is sometimes poorly tuned to predicting our own memory successes and follies. For example, we think we will remember details of things we have encountered many times, such as the Apple logo, the American flag, the location of a fire extinguisher, emergency instructions on an airplane, **WARNINGS IN LARGE LETTERS**, secret passwords and where we have hidden a special object. Only later do we realize that we don’t quite remember things as well as we think.

Although people often describe how they are prone to forgetting, people also think their memory is fairly stable over time (Koriat, Bjork, Sheffer, & Bar, 2004; Kornell & Bjork, 2009). Thus, assessments of forgetting introduce a paradox: individuals frequently decry their isolated memory failures but, in many experiments, make predictions assuming that they will forget very little. Other work (e.g., Castel, Rhodes, McCabe, Soderstrom, & Loaiza, 2012; Rhodes, Witherby, Castel, & Murayama, 2017) suggests that when we do forget we may exhibit a predictable tendency to devalue that information. In addition to these tendencies, our perceptions of memory may change across the lifespan. For instance, aging may heighten awareness of memory success and failures, possibly because older adults

have experienced more memory errors and, as a result of experience (and perhaps the anxiety associated with past failures), know what to focus on to remember. Noticing what we remember and forget may be the best way to improve memory across the lifespan, if we can use this knowledge to guide future memory efforts in our often-distracted state and world of information. Thus, understanding the quirks of forgetting may be a valuable method that allows us all to be better users of our memory abilities.

The Nature of Forgetting

No exploration of forgetting would be complete without some comment on its form (see Roediger et al., 2010; Wixted, 2004, for splendid reviews). In general, the form of forgetting appears to hew to patterns first reported by Herman Ebbinghaus (1885) in his seminal studies of his own memory. In particular, after a bout of learning, forgetting appears to proceed rapidly and then slow, reaching asymptotic stability, and is likely best characterized by a power law (see Wixted, 2004; Wixted & Carpenter, 2007). Theories of forgetting abound, positing mechanisms and processes ranging from the interference wrought by other information (Crowder, 1976; McGeoch, 1932), to the utility of cues or hints available (e.g., Watkins & Watkins, 1976), to competition between responses (Anderson, Bjork, & Bjork, 1994), to a host of physiological processes (Wixted, 2004).

In the midst of cataloging explanations and the form of forgetting, an equally valuable question considers its function. We may decry slips of memory in conversations in a social gathering but is there a greater, beneficial function to forgetting? One primary function of forgetting, noted by a number of investigators (e.g., Anderson et al., 1994), is that it ensures that memory is less subject to the minutia or detritus of our experiences and more attuned to important information (Castel, 2008). For instance, it is of little value to remember what one ordered for lunch 9 weeks ago or where parking was secured on a trip to the supermarket 2 years ago, but it will be important to recall a daughter's birthday, the correct dosage of a medicine crucial to heart health, plans for retirement, etc. Thus, forgetting might be usefully considered a type of mental thresher, separating the wheat of the most important information we need from the chaff of the less valuable knowledge, experiences, and day-to-day details. Admittedly, although it often functions superbly, this mental thresher is decidedly imperfect and admits some chaff and loses some wheat, perhaps giving rise to our complaints about forgetting.

Is forgetting really the enemy of learning or does it serve an important role? Bjork and Bjork (1992; see also Bjork, 1989, 2011; Bjork & Bjork, 2019) have long made the case that we should welcome forgetting and regard it as a friend rather than a foe. Indeed, many activities that appear to result in substantial initial levels of forgetting may forge superior learning in the long run, despite the initial impression that forgetting hurts performance.

Consider, for example, math instruction. The approach taken by the typical math textbook is to teach students a single formula or concept (e.g., Cartesian formulas), provide practice on this material, and then to move on to the next concept (e.g., the Pythagorean theorem). Such blocking of the same material can be contrasted with interleaving, whereby concepts are mixed together within a learning session. For instance, students might learn about calculating slopes and intercepts along with the Pythagorean theorem, and then practice problems focusing on a mix of these concepts. Rohrer and Taylor (2007) tested this by having participants learn to solve for the area of less-common geometric shapes, such as a wedge and spheroid. All participants learned four different formulas. Half learned a formula and then completed four practice problems, doing this for each formula in succession using blocked practice. The other half of the participants learned all four formulas at once and then did

practice on all 16 problems randomly intermixed together, thus engaging in interleaved practice. Interestingly, performance on the practice problems, given just after learning, was much better for the blocked than the interleaved condition. However, on a final test given a week later, interleaving resulted in far superior performance than blocking. Although mixing problems (interleaving) led to more forgetting up front, it promoted more durable learning in the long run (see Soderstrom & Bjork, 2015, for a review). Thus, forgetting might not only reduce the clutter in our memories, but conditions that promote forgetting appear to enhance learning. However, a question lingers: how well do we understand memory and forgetting?

Metamemory Accuracy and Biases

Metamemory refers to the ability to evaluate our own memory, and that of others. There are a variety of ways to assess metamemory (see Dunlosky & Tauber, 2016) and one common method is to simply ask people, after they have been presented with some bit of information, how well they will later recall it (see Rhodes, 2016). Often, people are fairly accurate, and this holds true for both younger college-age students and healthy older adults over 60 (Hertzog, Kidder, Powell-Moman, & Dunlosky, 2002). However, important biases have been identified, such that people may be overconfident (Metcalf, 1998) or biased by certain cues that do not in fact influence memory (see Chapter 10 in this volume). Furthermore, in some cases, people will show strong false memories that are accompanied by high levels of confidence (Loftus, 1992).

People may be biased by superficial features, such that words in large font feel like they will be better remembered. We (Rhodes & Castel, 2008) have studied how font size impacts metamemory judgments and often find that people predict they will better remember words presented in larger font than words that are still easy to read but in smaller font (see Figure 9.1 for a demonstration). Actually, font size has only the smallest impact on later memory (see Luna, Martín-Luengo, & Albuquerque, 2017, for a review; but see also Undorf & Zimdahl, 2019). Thus, people report words in large font to be more memorable, but font size is not diagnostic of later memory. This memory illusion related to font size and recall occurs even when people's beliefs have been modified such that they have reason to believe that font plays little role in memory (Blake & Castel, 2018; see also Mueller, Dunlosky, Tauber, & Rhodes 2014). The font size illusion could lead people to think that they will later remember signs in large letters (such as EMERGENCY EXIT) but in a subsequent fire emergency they have little recollection of where they saw this sign. Thus, making something seem easy to learn might lead to fast forgetting, despite our intuition that things in larger font are easier and better remembered.

Habituation and Memory Bias

Repeated exposure might also engender the strong feeling that something will be remembered well and avoid being forgotten. However, while repetition can often enhance memory, it may

Dog – Fork

or

Cat – Book

Figure 9.1 What word pair do you think you will better remember? Most people think the pair in larger font size will be better remembered, either because it is easier to read (more fluent) and/or because people have the belief that words in larger font are usually more important (Rhodes & Castel, 2008).

inflate one's metamemory to the point of overconfidence. In addition, repeated exposure can lead to habituation whereby we stop noticing details of these objects or events (Mack, 2003; Simon, 2000). This has been demonstrated with common objects such as a penny (Nickerson & Adams, 1979); although pennies have been seen thousands of times, individuals often fail to accurately recall features such as which way does Lincoln's face point: left or right? In terms of reading and letter recognition, despite having seen the lower-case letter "g" in Times New Roman font millions of times (and many times in this chapter), people fail to notice that it is in this form with a "loop-tail" (i.e., "g") and think it is in the form of an "open-tail" g (i.e., "g") (Wong et al., 2018). People are often unaware of failing to notice these events or features, suggesting that metacognition is not tuned to our lack of awareness or what we don't notice (termed "change blindness blindness," Levin, Momen, Drivdahl, & Simons, 2000). If you are curious, Lincoln faces to the left on the penny, but all other Presidential figures are facing to the right on nickel, dime and quarter, possibly creating interference.

As an interesting example of a real-world memory quirk driven by habituation, President Donald Trump was shown with students at a school drawing the flag of the United States (a symbol he knows very well), by coloring in a blue stripe in a widely publicized media photo (Fearnow, 2018). Even if we know something well, we might not recall details precisely and perhaps especially when we are put on the spot, sometimes due to anxiety. For example, singers may forget the words to the national anthem when singing in front of a large audience, and Texas Governor Rick Perry forgot which departments he wanted to abolish during a 2011 GOP debate (he first recalled Commerce, Education, and only 15 minutes later did he recall Energy), information he knew well but temporarily forgot during this stressful moment. More recently, President Trump appeared to color in a blue stripe on the American flag, as previously mentioned. In fact, we have poor recognition memory for the details of familiar flags despite high confidence that we know the flag, and this is especially pronounced around the 4th of July holiday, when we have seen many instances of the flag (Blake & Castel, 2019). If you do not believe this memory quirk for yourself, try the demonstration with the flag of the United States of America (Figure 9.2). The Apple logo also provides a striking demonstration. Most people feel they know the Apple logo, as we have been bombarded with this iconic symbol. Repeated exposure does not always lead to good memory for details. Although seen many times, we surprisingly may not remember details (such as whether there is a stem and/or leaf, and what side the bite is on), despite having high confidence (see Blake, Nazarian, & Castel, 2015 for more details).

Misremembering features of logos and flags may be a quirk, but this habituation and lack of metamemory accuracy can have some implications in the real world. For instance, do you know where the nearest fire extinguisher is located? Most people in a workplace environment have seen them many times and know they are somewhere—but where? Can you locate yours, either at home or at the office? If you struggle, it may be explained by "inattentive amnesia"—a failure to remember something you have seen (but perhaps not noticed) many times (Wolfe, 1999). One field study conducted at UCLA asked workers (while sitting at their office desk) where the nearest fire extinguisher was located. Many of these people felt like they knew where the fire extinguisher was located but, when they were asked to find it, they failed (see Figure 9.3). This experience of failed retrieval can actually turn into a beneficial learning event, partly because it points to our blind spots. When queried again three months later about the fire extinguisher, most participants were now able to locate it (Castel, Vendetti, & Holyoak, 2012). It remains to be seen (pun intended) if this might generalize to situations in which vision is compromised. For instance, suppose that a chemistry lab experiment has led to a small explosion and one's vision is compromised due to chemicals in the eyes. Could one locate an emergency eye-wash station that has been in plain view the entire

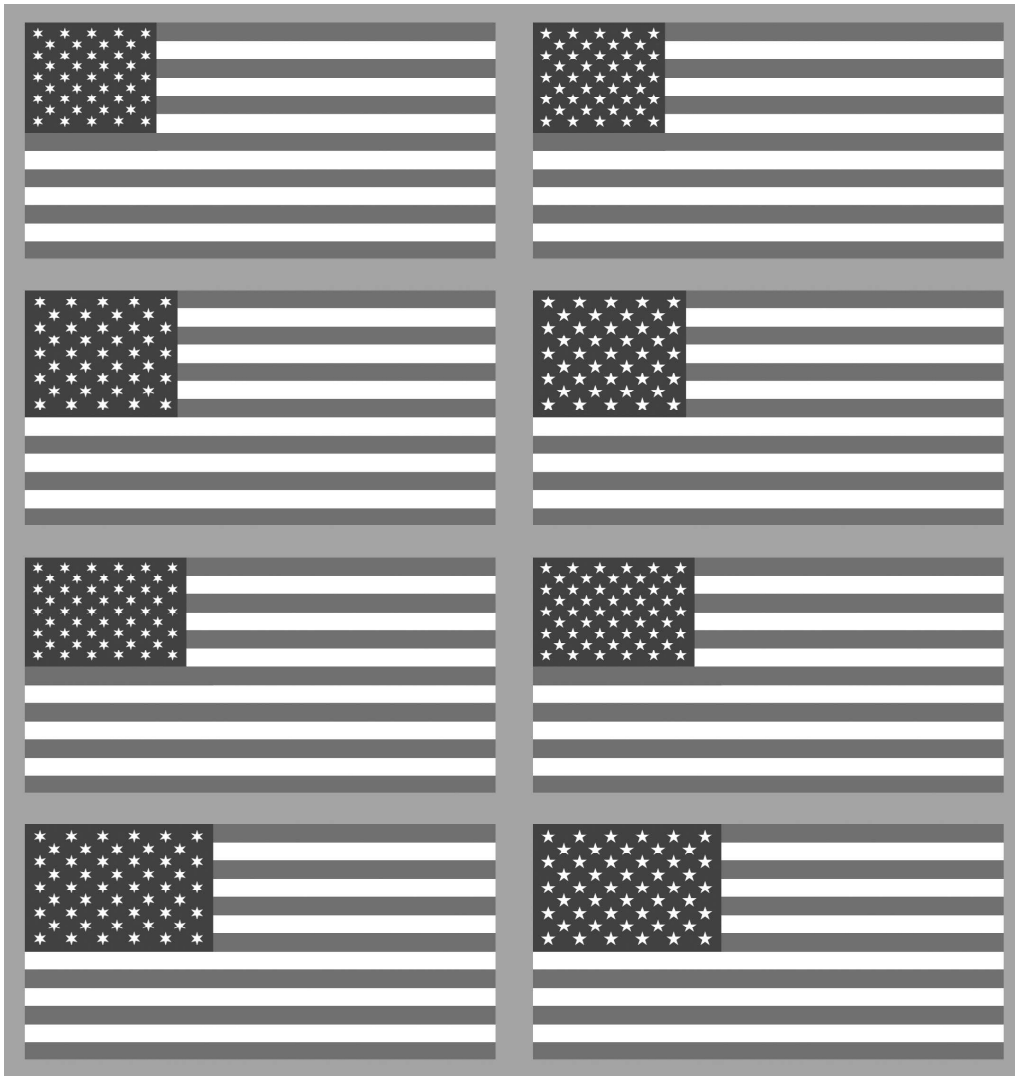


Figure 9.2 Can you find the correct US Flag? While we have partial information about the flag, have seen it many times (leading to high confidence), and know rules such as the number of stars and stripes, we may lack detailed information about other aspects. This leads to a metacognitive illusion that is especially pronounced when the flag is on display, such as before and after the 4th of July holiday (Blake & Castel, 2019). To find out the correct answer, please see the Appendix.

semester? Thus, one quirk of memory is that we might not notice our lack of awareness, as repeated exposure may create a powerful illusion of certainty.

Distraction and Habits = Memory Blunders?

People are often distracted, when on their phones, while driving, while in conversation, and this impacts memory. Can you think of the last time you forgot something that was really



Figure 9.3 We often stop noticing things in our environment that we see every day, referred to as “inattention blindness.” Furthermore, people seem to be unaware of not noticing, making the effect even more pronounced. Castel, Vendetti, and Holyoak (2012) asked participants to recall the location of the nearest fire extinguisher while in their office. Many did not know where it was, even if they walked past it every day, illustrating inattention blindness for a conspicuously-placed object. In one especially dramatic instance (shown above), the fire extinguisher had been right next to the person’s office door for more than 20 years!

important? This might include forgetting your passport for a trip or your spouse’s birthday. Although people can often remember the location of important objects in lab-based tasks (e.g., Siegel & Castel, 2018), a casual inspection of lost-and-founds at airports and gyms shows that people often leave behind their car keys, wallets, cell phones, and laptops—all vital objects of everyday life. People often forget where they have hidden important objects (Winograd & Soloway, 1986), passwords they have generated, and sometimes even the location of valuables hidden away long ago. One elderly man in France once hid a large amount of gold and valuable jewelry (worth over \$200,000) in his cluttered basement, presumably to keep it safe and prevent others from finding it. The only problem was that he forgot about his treasure a few years later when he moved houses (Taylor, 2012)! Thankfully, a few months after moving from this house into a retirement home, he remembered the collection of gold bars and jewelry he had left in his basement. Squatters had since invaded the house, but they were apparently oblivious to the gold mine beneath their feet. Police were soon able

to help find the gold—kept in a jar and wedged between piles of junk—and escorted the retiree to the bank.

One reason we might forget important things may be distraction. A particularly horrifying case is when parents, while driving a familiar route to work, forget they have a sleeping infant in the car—something that happens so often it has been termed “forgotten baby syndrome” (Fantz, 2015). This can lead to infant deaths and devastated parents whose memory is perfectly normal and usually high-functioning. These people have experienced a common occurrence of being distracted in a familiar routine of getting to their workplace, and forgot to drop off their child at daycare.

While some research shows that under certain levels of distraction we can selectively focus on remembering important information (Middlebrooks, Kerr, & Castel, 2017), one quirk of memory is that sometimes we forget the most important things because we are consumed by mind-wandering and distraction. On a more humorous note, a cartoon depicts two dinosaurs who see that they are late to the departure of Noah’s Ark, having just missed their ride to avoid the flood (and eventual extinction). One remarks to the other, “Oh shoot, was that today?”

Aging and Remembering Important Things

While it is unclear whether there is an evolutionary basis to remember certain information, there are times when our memory becomes tuned to remember things that might help us survive. This could take the form of helping us to distinguish between food that we can eat safely versus food that has made us sick in the past. Although younger adults usually have better memory abilities relative to older adults, aging may bring with it an ability to selectively remember what is most important (Castel, 2008), especially when context can guide memory (Hess, 2005). Thus, despite memory challenges, older adults can remember things that matter to them, such as interesting trivia (McGillivray, Murayama, & Castel, 2015), what essential items to pack on a trip (McGillivray & Castel, 2017), grocery items and sale prices (Castel, 2008; Flores, Hargis, McGillivray, Friedman, & Castel, 2017), allergens (Middlebrooks et al., 2016), and weather forecasts (see Figure 9.4 by Gallo, Hargis, & Castel, 2019). While older adults may sometimes have difficulty remembering precise information, such as remembering “it will be 92 degrees this weekend,” they will remember the

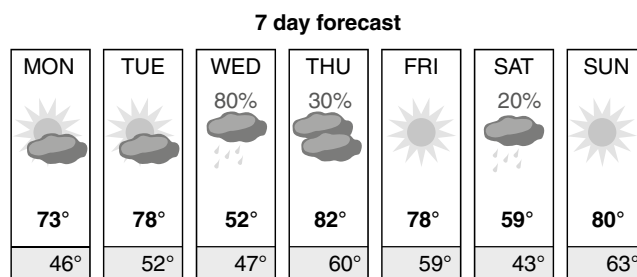


Figure 9.4 After planning a picnic, could you later remember what day you had chosen? While older adults may struggle to remember information in lab-based settings, older adults can remember the main theme or gist. For example, when presented with a weather forecast and a goal of remembering what days are sunny or rainy (i.e., the gist and not specifics such as exact temperatures), older adults remember what day would be best to plan a picnic (Gallo, Hargis, & Castel, 2019). This suggests that older adults can better remember information that is most relevant to plan and complete goals.



Figure 9.5 Older adults often have trouble remembering associations, such as names and faces. However, with repeated exposure and testing, older adults are able to selectively remember important associations that are of critical importance, such as medication interactions that could cause a severe side effect (Hargis & Castel, 2018a, 2018b).

gist, such as “it will be hot this weekend” (Brainerd, Reyna, & Howe, 2009). Perhaps experiencing many past memory challenges makes older people focus on remembering what is most important and remembering the gist to offset forgetting details.

Older adults often exhibit deficits in associative memory when remembering unrelated word pairs (Naveh-Benjamin, 2000), such as those shown in Figure 9.1. However, when realistic materials and frequent testing sessions are employed, older adults may be able to remember important associations (Castel, 2008). This can take the form of remembering the names and faces of people that one cares about, such as a friend or doctor that will be seen again in the future (Hargis & Castel, 2017). In addition, with repeated studying and testing, older adults can selectively remember what medications should not be taken together as this mix might lead to a dangerous medication interaction (Hargis & Castel 2018a, 2018b, see Figure 9.5).

Although older adults experience challenges remembering associations, such as between names and faces, a lifetime of experiencing memory challenges may be an asset. Awareness that it is difficult to remember, coupled with frequent testing, may help older adults focus on what matters most in everyday life (which may differ from what is often tested in the lab). In order to better tune our metamemory to our actual memory function, we need memory failures. While most teachers feel that “perfect practice makes perfect,” this motto itself may be imperfect. It is important to experience failures (ideally when the costs are low), including forgetting, so that one can benefit from learning from mistakes; this form of learning can be very potent and long lasting.

Feelings and Fear of Forgetting

One motivation for remembering important things may be the fear associated with forgetting. People do not want to miss their flight, forget their babies, or, as often reported as a common and reoccurring nightmare, forget to put on their pants before going to school or work. Thus, anxiety may encourage people to focus on remembering. However, sometimes this can be misguided, as people (especially healthy older adults) may experience stress about forgetting names—even if names may not be critical to remember in the grand scheme of things. Whereas failing to remember important things consistently and on a day-to-day

basis (such as wearing pants) may be a sign of dementia (Castel, Balota, & McCabe, 2009), occasional absent mindedness is usually nothing to worry about as it is common at many stages in life.

Another quirk of memory is the vague worry that we might be forgetting something important. People often report dreams where they have gone to school, or work, and about halfway through the dream realize that they have forgotten to wear pants. These dreams are typically anxiety-evoking, for a number of embarrassing reasons, but for the purposes of the present chapter illustrate how important it is to remember to do certain things in the morning, before we head off for a busy and distracted day. People often experience anxiety when their memory is challenged and this anxiety could influence how we attempt to remember (Davidson, Dixon, & Hultsch, 1991).

As you are rushing to take a trip, have you ever felt that you are forgetting something? While these feelings can often mean we are indeed forgetting something(s) (Halamish, McGillivray, & Castel, 2011), they also show we have some capacity to know what we don't know, and attach some fleeting feeling to the loss of information. In addition, certain stereotypes (such as older people have worse memory) can negatively impact how older adults perform on memory test, and can be made worse by asking older adults about their age prior to the test (Hess et al., 2003). When anxiety about memory can be reduced, such as first giving older adults task success on a memory test (see Geraci & Miller, 2013), memory can be improved. Thus, our feelings and fear associated with memory tests can impact our performance but may also make us more aware of how our memory works under conditions of stress.

Gone and Less Important: A Forgetting Bias

Forgetting may be related to the importance of information, such that more important information is favored (and more likely to be retained) than less important information. But how does importance shape our perception of forgetting after it has occurred? For example, suppose you began your work day making a mental note to schedule an appointment. By the end of the day, you realize you forgot to make the appointment and it is too late to call. How would you evaluate this forgetting? Several sets of experiments we have reported (Castel et al., 2012; Rhodes et al., 2017; Witherby et al., 2019) suggest that people evaluate these lapses by devaluing the importance of the information. That is, we might reflect on the forgotten appointment by thinking something like, "Oh, it was probably not that important; I can do this tomorrow."

One way to experimentally examine this issue is to have people learn items that vary in importance. In an experiment that used this value-directed format, participants learned a set of words where each was associated with a different point value indicating how important that information was to remember (e.g., apple 12, donkey 3, table 9, etc.). As shown in a host of prior experiments, participants remembered important (valuable) information better than less valuable information (Castel, 2008). Our interest, however, was in a judgment we solicited after participants had tried to recall all of the information they had studied. In particular, we showed participants each word they had studied and asked them to remember its value when first studied. A consistent pattern emerged—on the average, a forgotten word was rated as less valuable than a remembered word. Thus, if you had seen "table 9" but later forgot this pairing, you are likely to under-estimate the original value of table (e.g., think "table" was worth 7 points).

Indeed, our conclusion was that participants made this judgment via a two-step process (Rhodes et al., 2017). First, they attempted to determine whether they had remembered

the item on the prior test. Next, based on that, importance was either upgraded (if it had been remembered) or downgraded (if it had been forgotten). Probably the most compelling evidence for this account came when participants mistakenly believed that they had forgotten a word. For instance, in one experiment, we first had participants tell us (“yes” or “no”) whether a word was remembered and then report how valuable it was. Based on this, we could determine whether the memory judgment was accurate (e.g., a word was recalled previously and correctly regarded as remembered) or inaccurate (e.g., a word was forgotten previously but mistakenly regarded as remembered). Interestingly, when forgotten words were mistakenly judged to be remembered, participants provided the same value judgments as if they remembered the information. Further work showed that these biases regarding the importance of forgotten information applied similarly with older adults (Witherby et al., 2019), belying our assumption that more experience with forgetting might temper the bias to deem forgotten information to be less valuable.

Thus, one way we move on after forgetting to make an appointment is to devalue its importance. This has some practical implications, as it may influence how we look back on our impressions of certain negative or positive events or traits of people we have met in the past (Ray et al., 2018), and that we may remember the gains and tend to devalue the losses (Castel et al., 2016; Gödker, Jiao & Smeets, 2019). In this way, a forgetting bias can make forgotten information seem less valuable, and there may (or may not) be good reasons why we need to accurately remember the value of what has been forgotten.

Summary

Quirks: Why Do We Sometimes Forget Important Things and Don't Predict It?

Our memory is quirky in that we may remember things we don't really care about (the jingle from a car commercial from 20 years ago) and forget things we do care about (a name of a colleague, or more consequentially, a baby we placed in the backseat of our car 20 minutes ago). While people often experience forgetting most intensely as related to proper names, people may not always be aware of the nature of forgetting in general. Unlike a computer, forgetting is a natural and sometime beneficial property of our human memory system—and thus we are often surprised when we forget something. We suggest that one reason this quirk exists is that our metamemory is often out of tune with our actual memory. People think we should remember what is important (and we often do) but when we forget something important we either dismiss it and/or can't believe it would happen to us. No one really thinks they would forget about their baby in the car, but this too often happens to people. While some of these quirks can be described in terms of our world of distraction, there are many instances where we do not fully appreciate or understand how our own memory works until it fails us, and that is our essential memory quirk quandry.

References

- Anderson, M.C., Bjork, R.A., & Bjork, E.L. (1994). Remembering can cause forgetting: retrieval dynamics in long-term memory. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 20, 1063–1087.
- Bjork, R.A. (1989). An adaptive mechanism in human memory. In H.L. Roediger & F.I.M. Craik (Eds.), *Varieties of Memory and Consciousness: Essays in Honour of Endel Tulving* (pp. 309–330). Hillsdale, NJ: Lawrence Erlbaum.

- Bjork, R.A. (2011). On the symbiosis of learning, remembering, and forgetting. In A.S. Benjamin (Ed.), *Successful remembering and successful forgetting: a Festschrift in honor of Robert A. Bjork* (pp. 1–22). London: Psychology Press.
- Bjork, R.A., & Bjork, E.L. (1992). A new theory of disuse and an old theory of stimulus fluctuation. In A.F. Healy, S.M. Kosslyn, & R.M. Shiffrin (Eds.), *From learning processes to cognitive processes: Essays in honor of William K. Estes*, (Vol. 2, pp. 35–67). Hillsdale, NJ: Lawrence Erlbaum.
- Bjork, R.A., & Bjork, E.L. (2019) Forgetting as the friend of learning: Implications for teaching and self-regulated learning. *Advances in Physiology Education*, *43*, 164–167.
- Blake, A.B., & Castel, A.D. (2019). Memory and availability-biased metacognitive illusions for flags of varying familiarity. *Memory & Cognition*, *47*, 365–382.
- Blake, A.B., & Castel, A.D. (2018). On belief and fluency in the construction of judgements of learning: Assessing and altering the direct effects of belief. *Acta Psychologica*, *186*, 27–38.
- Blake, A.B., Nazarian, M., & Castel, A.D. (2015). The Apple of the mind’s eye: Everyday attention, metamemory, and reconstructive memory for the Apple logo. *Quarterly Journal of Experimental Psychology*, *68*, 858–865.
- Brainerd, C.J., Reyna, V.F., & Howe, M.L. (2009). Trichotomous processes in early memory development, aging, and neurocognitive impairment: A unified theory. *Psychological Review*, *116*, 783–832.
- Castel, A.D. (2008). The adaptive and strategic use of memory by older adults: Evaluative processing and value-directed remembering. In A.S. Benjamin & B.H. Ross (Eds.), *The Psychology of Learning and Motivation* (Vol. 48, pp. 225–270). London: Academic Press.
- Castel, A.D., Balota, D.A., & McCabe, D.P. (2009). Memory efficiency and the strategic control of attention at encoding: Impairments of value-directed remembering in Alzheimer’s disease. *Neuropsychology*, *23*, 297–306.
- Castel, A.D., Friedman, M.F., McGillivray, S., Flores, C.C., Murayama, K., Kerr, T., & Drolet, A. (2016). I owe you: Age-related similarities and differences in associative memory for gains and losses. *Aging, Neuropsychology, and Cognition*, *23*, 549–565.
- Castel, A.D., Rhodes, M.G., McCabe, D.P., Soderstrom, N.C., & Loaiza, V.M. (2012). The fate of being forgotten: Information that is initially forgotten is judged as less important. *Quarterly Journal of Experimental Psychology*, *65*, 2281–2287.
- Castel, A.D., Vendetti, M., & Holyoak, K.J. (2012). Fire drill: Inattention blindness and amnesia for the location of fire extinguishers. *Attention, Perception, & Psychophysics*, *74*, 1391–1396.
- Crowder, R. (1976). *Principles of Learning and Memory*. Hillsdale, NJ: Lawrence Erlbaum.
- Davidson, H.A., Dixon, R.A., & Hultsch, D.F. (1991). Memory anxiety and memory performance in adulthood. *Applied Cognitive Psychology*, *5*(5), 423–433.
- Dunlosky, J., & Tauber, S.U.K. (Eds.) (2016). *The Oxford Handbook of Metamemory*. New York: Oxford University Press.
- Ebbinghaus, H. (1885). *Über das gedächtnis: untersuchungen zur experimentellen psychologie*. Duncker & Humblot.
- Fantz, A. (2015, January). After leaving a child in the car, “that pain never goes away”. Retrieved from *CNN*. www.cnn.com/2014/07/03/us/hot-car-deaths/index.html
- Fearnow, B. (2018, August). Donald Trump colored the American flag in wrong. Retrieved from *Newsweek*. www.newsweek.com/flag-donald-trump-color-marker-incorrect-stripes-american-flag-us-flag-1090990
- Flores, C.C., Hargis, M.B., McGillivray, S., Friedman, M.C., & Castel, A.D. (2017). Gist-based memory for prices and “better buys” in younger and older adults. *Memory*, *25*, 565–573.
- Gallo, H.B., Hargis, M.B., & Castel, A.D. (2019). Memory for weather information in younger and older adults: Tests of verbatim and gist memory. *Experimental Aging Research*, *45*, 252–265.
- Geraci, L., & Miller, T.M. (2013). Improving older adults’ memory performance using prior task success. *Psychology and Aging*, *28*, 340–345.
- Gödker, K., Peiran, J., & Smeets, P. (2019). Investor memory. Available at *SSRN*: <https://ssrn.com/abstract=3348315> or <http://dx.doi.org/10.2139/ssrn.3348315>
- Halamish, V., McGillivray, S., & Castel, A.D. (2011). Monitoring one’s own forgetting in younger and older adults. *Psychology and Aging*, *26*, 631–635.

- Hargis, M.B., & Castel, A.D. (2017). Younger and older adults' associative memory for social information: The role of information importance. *Psychology and Aging, 32*(4), 325–330.
- Hargis, M.B., & Castel, A.D. (2018a). Improving medication understanding and adherence using principles of memory and metacognition. *Policy Insights from Behavioral and Brain Sciences, 5*, 147–154.
- Hargis, M.B., & Castel, A.D. (2018b). Younger and older adults' associative memory for medication interactions of varying severity. *Memory, 26*, 1151–1158.
- Hertzog, C., Kidder, D.P., Powell-Moman, A., & Dunlosky, J. (2002). Aging and monitoring associative learning: Is monitoring accuracy spared or impaired? *Psychology and Aging, 17*, 209–225.
- Hess, T.M. (2005). Memory and aging in context. *Psychological Bulletin, 131*, 383–406.
- Hess, T.M., Auman, C., Colcombe, S. J., & Rahhal, T.A. (2003). The impact of stereotype threat on age differences in memory performance. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences, 58*, P3-P11.
- Koriat, A., Bjork, R.A., Sheffer, L., & Bar, S.K. (2004). Predicting one's own forgetting: The role of experience-based and theory-based processes. *Journal of Experimental Psychology: General, 133*, 643–656.
- Kornell, N., & Bjork, R.A. (2009). A stability bias in human memory: Overestimating remembering and underestimating learning. *Journal of Experimental Psychology: General, 138*, 449.
- Levin, D.T., Momen, N., Drivdahl IV, S.B., & Simons, D.J. (2000). Change blindness blindness: The metacognitive error of overestimating change-detection ability. *Visual Cognition, 7*, 397–412.
- Loftus, E.F. (1992). When a lie becomes memory's truth: Memory distortion after exposure to misinformation. *Current Directions in Psychological Science, 1*, 121–123.
- Luna, K., Martín-Luengo, B., & Albuquerque, P.B. (2017). Do delayed judgments of learning reduce metamemory illusions? A meta-analysis. *Quarterly Journal of Experimental Psychology, 71*, 1626–1636.
- Mack, A. (2003). Inattention blindness: Looking without seeing. *Current Directions in Psychological Science, 12*, 180–184.
- McGeoch, J.A. (1932). Forgetting and the law of disuse. *Psychological Review, 39*, 352–370.
- McGillivray, S., & Castel, A.D. (2017). Older and younger adults' strategic control of metacognitive monitoring: The role of consequences, task experience and prior knowledge. *Experimental Aging Research, 43*, 233–256.
- McGillivray, S., Murayama, K., & Castel, A.D. (2015). Thirst for knowledge: The effects of curiosity and interest on memory in younger and older adults. *Psychology and Aging, 30*, 835–841.
- Metcalf, J. (1998). Cognitive optimism: Self-deception or memory-based processing heuristics? *Personality and Social Psychology Review, 2*, 100–110.
- Middlebrooks, C.D., Kerr, T.K., & Castel, A.D. (2017). Selectively distracted: Divided attention and memory for important information. *Psychological Science, 28*, 1103–1115.
- Middlebrooks, C.D., McGillivray, S., Murayama, K., & Castel, A.D. (2016). Memory for allergies and health foods: How younger and older adults strategically remember critical health information. *Journal of Gerontology: Psychological Sciences, 71*, 389–399.
- Mueller, M.L., Dunlosky, J., Tauber, S.K., & Rhodes, M.G. (2014). The font-size effect on judgments of learning: Does it exemplify fluency effects or reflect people's beliefs about memory? *Journal of Memory and Language, 70*, 1–12.
- Naveh-Benjamin, M. (2000). Adult age differences in memory performance: Tests of an associative deficit hypothesis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 1170–1187.
- Nickerson, R.S., & Adams, M.J. (1979). Long-term memory for a common object. *Cognitive Psychology, 11*, 287–307.
- Ray, D.G., Gomillion, S., Pinteá, A.I., & Hamlin, I. (2018). On being forgotten: Memory and forgetting serve as signals of interpersonal importance. *Journal of Personality and Social Psychology, 116*, 259–276.
- Rhodes, M.G. (2016). Judgments of learning. In J. Dunlosky and S.K. Tauber (Eds.), *The Oxford Handbook of Metamemory* (pp. 65–80). New York: Oxford University Press.

- Rhodes, M.G., & Castel, A.D. (2008). Memory predictions are influenced by perceptual information: Evidence for metacognitive illusions. *Journal of Experimental Psychology: General*, *137*, 615–625.
- Rhodes, M.G., Witherby, A.E., Castel, A.D., & Murayama, K. (2017). Explaining the forgetting bias effect on value judgments: The influence of memory for a past test. *Memory & Cognition*, *45*, 362–374.
- Roediger, III, H.L., Weinstein, Y., & Agarwal, P.K. (2010). Forgetting: Preliminary considerations. In *Forgetting* (pp. 15–36). New York: Psychology Press.
- Rohrer, D., & Taylor, K. (2007). The shuffling of mathematics problems improves learning. *Instructional Science*, *35*, 481–498.
- Siegel, A.L.M., & Castel, A.D. (2018). The role of attention in remembering important item-location associations. *Memory & Cognition*, *46*, 1248–1262.
- Simons, D.J. (2000). Attentional capture and inattention blindness. *Trends in Cognitive Sciences*, *4*, 147–155.
- Soderstrom, N.C., & Bjork, R.A. (2015). Learning versus performance: An integrative review. *Perspectives on Psychological Science*, *10*, 176–199.
- Taylor, A. (2012, June). A forgetful French gold bug left gold bars worth \$250,000 in his old basement. *Business Insider*. Retrieved from www.businessinsider.com/france-gold-forget-bourdeaux-2012-6
- Undorf, M., & Zimdahl, M.F. (2019). Metamemory and memory for a wide range of font sizes: What is the contribution of perceptual fluency? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *45*, 97–109.
- Watkins, M.J., & Watkins, O.C. (1976). Cue-overload theory and the method of interpolated attributes. *Bulletin of the Psychonomic Society*, *7*, 289–291.
- Winograd, E., & Soloway, R.M. (1986). On forgetting the locations of things stored in special places. *Journal of Experimental Psychology: General*, *115*, 366–372.
- Witherby, A.E., Tauber, S.K., Rhodes, M.G., & Castel, A.D. (2019). Aging and forgetting: Forgotten information is perceived as less important than remembered information. *Psychology and Aging*, *34*, 228–241.
- Wixted, J.T. (2004). The psychology and neuroscience of forgetting. *Annual Review of Psychology*, *55*, 235–269.
- Wixted, J.T., & Carpenter, S.K. (2007). The Wickelgren power law and the Ebbinghaus savings function. *Psychological Science*, *18*, 133–134.
- Wolfe, J.M. (1999). Inattentional amnesia. In V. Coltheart (Ed.), *Fleeting Memories* (pp. 71–94). Cambridge, MA: MIT Press.
- Wong, K., Wade, F., Ellenblum, G., & McCloskey, M. (2018). The devil's in the g-tails: Deficient letter-shape knowledge and awareness despite massive visual experience. *Journal of Experimental Psychology: Human Perception and Performance*, *44*(9), 1324–1335.

Appendix

In Figure 9.2, the correct US flag is the last option, as the other flags have different stars shapes/size of blue section or begin with a white not red stripe.